
**Industrial automation systems and
integration — Process specification
language —**

**Part 13:
Duration and ordering theories**

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*Systemes d'automatisation industrielle et integration — Langage de
specification de procede —
Partie 13: Theories de classement et de duree*

ISO 18629-13:2006

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Contents	Page
1 Scope	1
2 Normative references	1
3 Terms, definitions, and abbreviations	2
3.1 Terms and definitions	2
3.2 Abbreviations	6
4 General information on ISO 18629	6
5 Organization of this part of ISO 18629	7
6 Subactivity occurrence ordering core Theory	7
6.1 Primitive Relations of the Subactivity occurrence ordering theory.....	8
6.2 Defined Relations of the Subactivity occurrence ordering theory.....	8
6.3 Relationship to other sets of axioms.....	8
6.4 Informal Semantics of the Subactivity occurrence ordering theory	8
6.4.1 soo	8
6.4.2 soo_precedes	9
6.4.3 soomap.....	9
6.5 Definitions in the Subactivity occurrence ordering theory.....	9
6.5.1 Definition 1 (related to root_soo).....	9
6.5.2 Definition 2 (related to leaf_soo).....	9
6.5.3 Definition 3 (related to next_soo).....	10
6.6 Axioms of the Subactivity occurrence ordering theory.....	10
6.6.1 Axiom 1.....	10
6.6.2 Axiom 2.....	10
6.6.3 Axiom 3.....	10
6.6.4 Axiom 4.....	11
6.6.5 Axiom 5.....	11
6.6.6 Axiom 6.....	11
6.6.7 Axiom 7.....	11
6.6.8 Axiom 8.....	12
7 Duration theory	12
7.1 Primitive relations in the Duration theory	12
7.2 Primitive Functions and Constants.....	12
7.3 Defined Relations of the Duration theory	12
7.4 Relationship to other sets of axioms.....	13
7.5 Informal Semantics of the Duration theory	13
7.5.1 timeduration.....	13
7.5.2 lesser.....	13
7.5.3 duration.....	13
7.5.4 time_add.....	13
7.5.5 add.....	14
7.5.6 mult.....	14
7.5.7 zero.....	14
7.5.8 one.....	14

ISO 18629-13 : 2006 (E)

7.5.9	max+	14
7.5.10	max-	14
7.6	Definitions of Duration theory	14
7.6.1	Definition 1	14
7.7	Axioms for the Duration theory	15
7.7.1	Axiom 1	15
7.7.2	Axiom 2	15
7.7.3	Axiom 3	15
7.7.4	Axiom 4	16
7.7.5	Axiom 5	16
7.7.6	Axiom 6	16
7.7.7	Axiom 7	16
7.7.8	Axiom 8	16
7.7.9	Axiom 9	17
7.7.10	Axiom 10	17
7.7.11	Axiom 11	17
7.7.12	Axiom 12	17
7.7.13	Axiom 13	17
7.7.14	Axiom 14	18
7.7.15	Axiom 15	18
7.7.16	Axiom 16	18
7.7.17	Axiom 17	18
7.7.18	Axiom 18	19
7.7.19	Axiom 19	19
7.7.20	Axiom 20	19
7.7.21	Axiom 21	19
7.7.22	Axiom 22	20
8	Occurrence tree automorphisms	20
8.1	Primitive Relations in the Occurrence tree automorphism theory	20
8.2	Defined Relations in the Occurrence tree automorphism theory	20
8.3	Relationship to other sets of axioms	21
8.4	Informal semantics of the Occurrence tree automorphism theory	21
8.4.1	ubiquitous	21
8.4.2	end_iso	21
8.4.3	legal_map	21
8.4.4	tree_map	22
8.5	Definitions in the Occurrence tree automorphism theory	22
8.5.1	Definition 1	22
8.5.2	Definition 2	22
8.5.3	Definition 3	23
8.6	Axioms for the Occurrence tree automorphism theory	23
8.6.1	Axiom 1	23
8.6.2	Axiom 2	24
8.6.3	Axiom 3	24

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9	Activity envelope theory	25
9.1	Primitive Relations in the Activity envelope theory	25
9.2	Defined relation in Activity envelope theory	25
9.3	Relationship to other sets of axioms.....	25
9.4	Informal semantics of the Activity envelope theory	25
9.4.1	envelope.....	25
9.4.2	umbra.....	26
9.5	Definitions in activity envelop theory	26
9.6	Axioms of the Activity envelope theory	26
9.6.1	Axiom 1.....	26
9.6.2	Axiom 2.....	26
9.6.3	Axiom 3.....	27
9.6.4	Axiom 4.....	27
9.6.5	Axiom 5.....	27
9.6.6	Axiom 6.....	27
9.6.7	Axiom 7.....	27
9.6.8	Axiom 8.....	28
	Annex A (normative) Use of ASN.1 Identifiers in SC4 standards.....	29
	Annex B (informative) Example of process description using ISO 18629-13.....	30
	Bibliography.....	38
	Index.....	39
	https://standards.iteh.ai/catalog/standards/sist/bced82c8-cff0-4716-8a1c-ee7b18dcb617/iso-18629-13-2006	
	Figures	
	Figure B1: TOP level process for manufacturing a GT350 [8].....	31
	Figure B.2: PROCESS for manufacturing the 350–Engine [8].....	33
	Figure B.3: PROCESS for manufacturing the 350–Block [8].....	34
	Figure B.4: PROCESS for manufacturing the 350–Harness [8]	35
	Figure B.5: PROCESS for manufacturing the harness wire [8].....	36
	Figure B.6 : Process for manufacturing the 350-Wire [8].....	36

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 18629 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18629-13 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 4, *Industrial data*.

A complete list of parts of ISO 18629 is available from the Internet:

<http://www.tc184-sc4.org/titles>

Introduction

ISO 18629 is an International Standard for the computer-interpretable exchange of information related to manufacturing processes. Taken together, all the parts contained in the ISO 18629 Standard provide a generic language for describing a manufacturing process throughout the entire production process within the same industrial company or across several industrial sectors or companies, independently from any particular representation model. The nature of this language makes it suitable for sharing process information related to manufacturing during all the stages of a production process.

This part of ISO 18629 provides a description of the core elements of the language defined within ISO 18629.

All parts of ISO 18629 are independent of any specific process representation or model proposed in a software application in the domain of manufacturing management. Collectively, they provide a structural framework for improving the interoperability of these applications.

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Industrial automation systems and integration — Process specification language —

Part 13: Duration and ordering theories

1 Scope

This part of ISO 18629 provides a representation of the primitive concepts related to ordering and durations constraints for activities.

The following is within the scope of this part of ISO 18629:

- subactivity occurrence orderings;
- duration;
- iterated occurrence orderings;
- occurrence tree endomorphisms;
- activity envelopes.

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2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8824-1: *Information technology — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of basic notation.*

ISO 15531-1: *Industrial automation systems and integration — Industrial manufacturing management data — Part 1: General overview.*

ISO 18629-1: *Industrial automation systems and integration — Process specification language — Part 1: Overview and basic principles.*

ISO 18629-11: 2005, *Industrial automation systems and integration — Process specification language — Part 11: PSL-core.*

ISO 18629-13 : 2006 (E)

ISO 18629-12: *Industrial automation systems and integration — Process specification language — Part 12: Outer core.*

3 Terms, definitions, and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1.1

automorphism

one-to-one mapping of elements on a set that preserves the relations and functions in some model

3.1.2

axiom

well-formed formula in a formal language that provides constraints on the interpretation of symbols in the lexicon of a language

[ISO 18629-1]

3.1.3

commutative group

algebraic structure with an internal binary operation (OP) with respect to which : $a \text{ OP } b = b \text{ OP } a$

3.1.4

conservative definition

definition that specifies necessary and sufficient conditions that a term shall satisfy and that does not allow new inferences to be drawn from the theory

[ISO 18629-1]

3.1.5

core theory

set of axioms for relation and function symbols that denote primitive concepts

[ISO 18629-1]

3.1.6

defined lexicon

set of symbols in the non-logical lexicon which denote defined concepts

NOTE Defined lexicon is divided into constant, function and relation symbols.

EXAMPLE terms with conservative definitions.

[ISO 18629-1]

3.1.7

endomorphism

mapping from a set onto a subset that preserves the relations and functions in some model

3.1.8

extension

augmentation of PSL-Core containing additional axioms

NOTE 1 The PSL-Core is a relatively simple set of axioms that is adequate for expressing a wide range of basic processes. However, more complex processes require expressive resources that exceed those of the PSL-Core. Rather than clutter the PSL-Core itself with every conceivable concept that might prove useful in describing one process or another, a variety of separate, modular extensions need to be developed and added to the PSL-Core as necessary. In this way a user can tailor the language precisely to suit his or her expressive needs.

NOTE 2 All extensions are core theories or definitional extensions.

[ISO 18629-1]

3.1.9

grammar

specification of how logical symbols and lexical terms can be combined to make well-formed formulae

[ISO 18629-1]

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3.1.10

homomorphism

mapping between sets that preserves some relation on the elements of the set

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3.1.11

interpretation

universe of discourse and assignment of truth values (TRUE or FALSE) to all sentences in a theory

NOTE See annex B for an example of an interpretation.

[ISO 18629-11]

3.1.12

language

combination of a lexicon and a grammar

[ISO 18629-1]

3.1.13

lexicon

set of symbols and terms

ISO 18629-13 : 2006 (E)

NOTE The lexicon consists of logical symbols (such as Boolean connectives and quantifiers) and non-logical symbols. For ISO 18629, the non logical part of the lexicon consists of expressions (constants, function symbols, and relation symbols) chosen to represent the basic concepts of the ontology.

[ISO 18629-1]

3.1.14 model

combination of a set of elements and a truth assignment that satisfies all well-formed formulae in a theory

NOTE 1 The word "model" is used, in logic, in a way that differs from the way it is used in most scientific and everyday contexts: if a sentence is true in a certain interpretation, it is possible to say that the interpretation is a model of the sentence. The kind of semantics presented here is often called model-theoretical semantics.

NOTE 2 A model is typically represented as a set with some additional structure (partial ordering, lattice, or vector space). The model then defines meanings for the terminology and a notion of truth for sentences of the language in terms of this model. Given a model, the underlying set of axioms of the mathematical structures used in the set of axioms then becomes available as a basis for reasoning about the concepts intended by the terms of the language and their logical relationships, so that the set of models constitutes the formal semantics of the ontology.

[ISO 18629-1]

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3.1.15 monomorphism

one to one mapping that preserves some relation on the elements of the set

[ISO 18629-13:2006](#)

3.1.16 ontology

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lexicon of specialised terminology along with some specification of the meaning of terms in the lexicon

NOTE 1: structured set of related terms given with a specification of the meaning of the terms in a formal language. The specification of meaning explains why and how the terms are related and conditions how the set is partitioned and structured.

NOTE 2: The primary component of a process specification language such as ISO 18629 is an ontology. The primitive concepts in the ontology according to ISO 18629 are adequate for describing basic manufacturing, engineering, and business processes.

NOTE 3: The focus of an ontology is not only on terms, but also on their meaning. An arbitrary set of terms is included in the ontology, but these terms can only be shared if there is an agreement about their meaning. It is the intended semantics of the terms that is being shared, not simply the terms.

NOTE 4: Any term used without an explicit definition is a possible source of ambiguity and confusion. The challenge for an ontology is that a framework is needed for making explicit the meaning of the terms within it. For the ISO 18629 ontology, it is necessary to provide a rigorous mathematical characterisation of process information as well as a precise expression of the basic logical properties of that information in the ISO 18629 language.

[ISO 18629-1]

3.1.17

Outer Core

set of core theories that are extensions of PSL-Core and that are so generic and pervasive in their applicability that they have been put apart

NOTE In practice, extensions incorporate the axioms of the Outer Core.

[ISO 18629-1]

3.1.18

primitive concept

lexical term that has no conservative definition

[ISO 18629-1]

3.1.19

primitive lexicon

set of symbols in the non-logical lexicon which denote primitive concepts

NOTE Primitive lexicon is divided into constant, function and relation symbols.

[ISO 18629-1]

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3.1.20

process

structured set of activities involving various enterprise entities, that is designed and organised for a given purpose

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NOTE The definition provided here is very close to that given in ISO 10303-49. Nevertheless ISO 15531 needs the notion of structured set of activities, without any predefined reference to the time or steps. In addition, from the point of view of flow management, some empty processes may be needed for a synchronisation purpose although they are not actually doing anything (ghost task).

[ISO 15531-1]

3.1.21

proof theory

set of theories and lexical elements necessary for the interpretation of the semantics of the language

NOTE It consists of three components: the PSL-Core, the Outer Core and the extensions.

[ISO 18629-1]

3.1.22

PSL-Core

set of axioms for the concepts of activity, activity-occurrence, time-point, and object